Improvements in the Version 4.0 QuikSCAT Ocean Vector Winds

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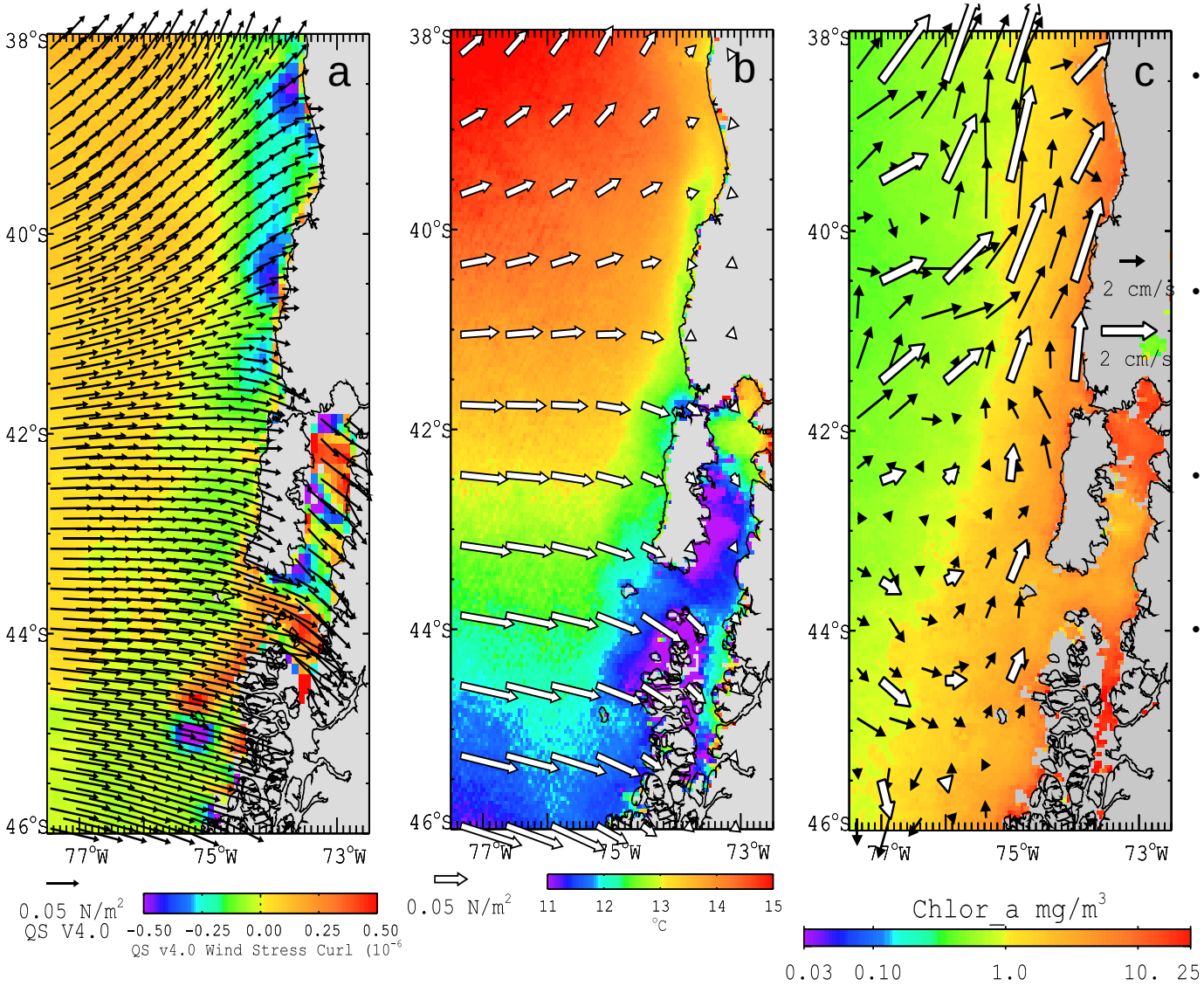
Overview

- Version 4.0 of the 10 years of operational QuikSCAT swath wind data products has been publicly released at the Physical Oceanography Data Active Archive Center (PO.DAAC) https://podaac.jpl.nasa.gov, The new version includes:
- Coastal processing: Land Contamination Ratio and Expected Sigma-0 (LCRES) flagging and correction
  - *Removes backscatter measurements for which expected land contribution is more than 0.004 (-24 dB)*
  - *If less than threshold, corrects for expected backscatter contribution from land*
  - *Uses expected land sigma-0 map computed from QuikSCAT measurements over land.*
  - *Retrieves wind from uncontaminated and corrected measurements*
  - *Reports a coregistered distance from coast quantity for each wind vector cell*
- New SST-dependent GMF (Ricciardulli and Wentz, 2018)
  - *Fixes speed biases with C-band scatterometers and radiometers in cold ocean.*
  - *Mostly effects VV polarization and thus outer single beam swath.*
- New simplified flagging strategy
  - *One flag bit denotes data that is likely to be contaminated by rain, sea-ice or other less frequent issues. Excludes 3% of data. This bit is NOT set for coastal processed data.*
  - *Another stricter flag is also included which flags all data that has the possibility of contamination including data near land (coastal processed data) near ice, near rain, and data for which the rain flag is undetermined. Excludes 15% of data.*

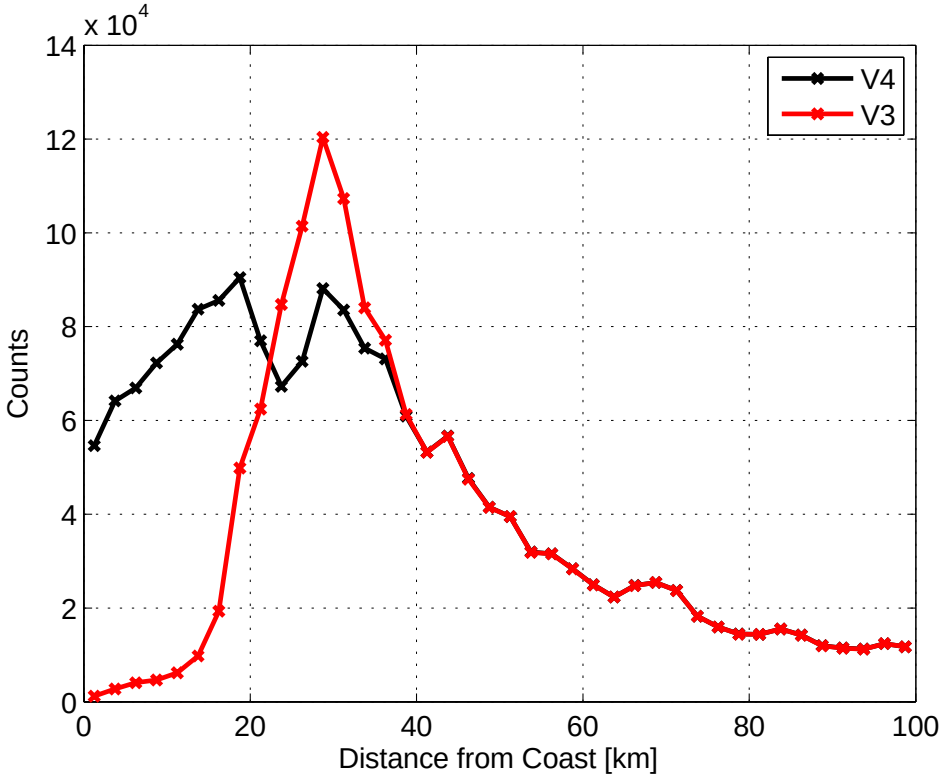
Utility of Coastal Winds

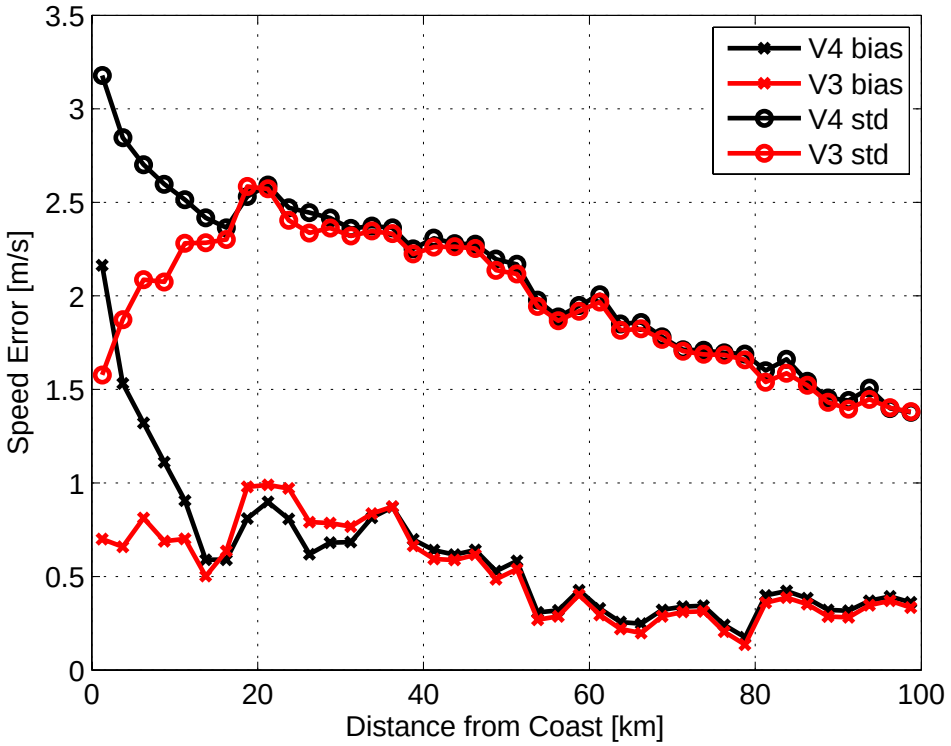
Mean Curl, SST, and Chlorophyll fields off S. Chile.



- Surface wind stress (QSCAT 1999-2009) (left figure, vectors) and wind stress curl (colors).
- Negative is upwelling favorable and the negative curl along the eastern side of Chiloe Island (~42-43.5 S) corresponds to cool SST next to the island in the middle figure.
- Positive curl and SST occur in the northern half of the inland sea. Negative patches of curl are also found near upwelling centers (40.0-40.5 S; 38.5-39.0 S)
- ECMWF winds (white vectors, middle figure) are much weaker in the inland sea than the SCAT winds.
- Surface geostrophic currents(right figure vectors (two different resolutions) and satellite CHL (colors). Note onshore winds and currents and warm SST between 39-40 S.

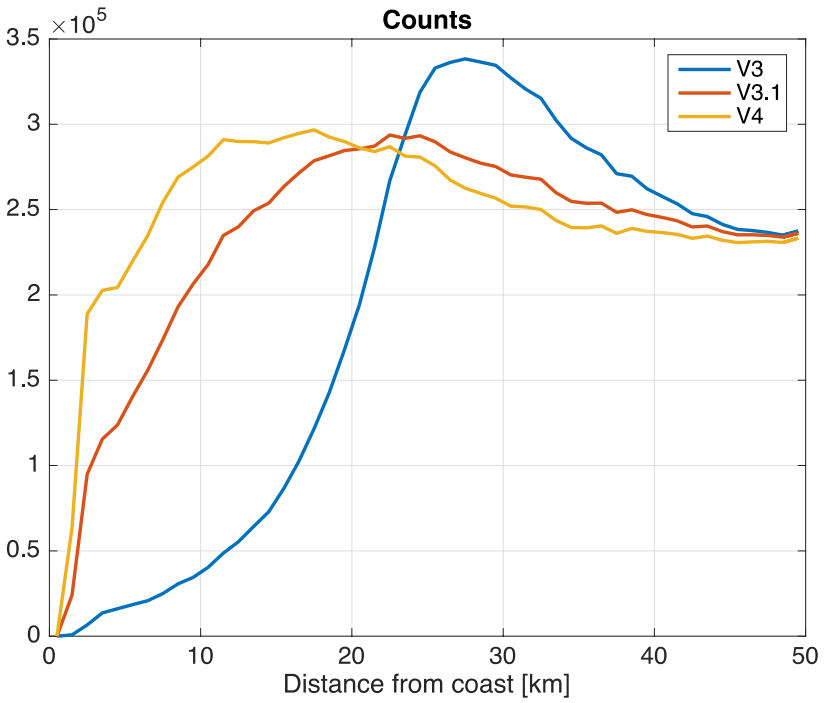
Coastal Wind Performance vs. Buoys

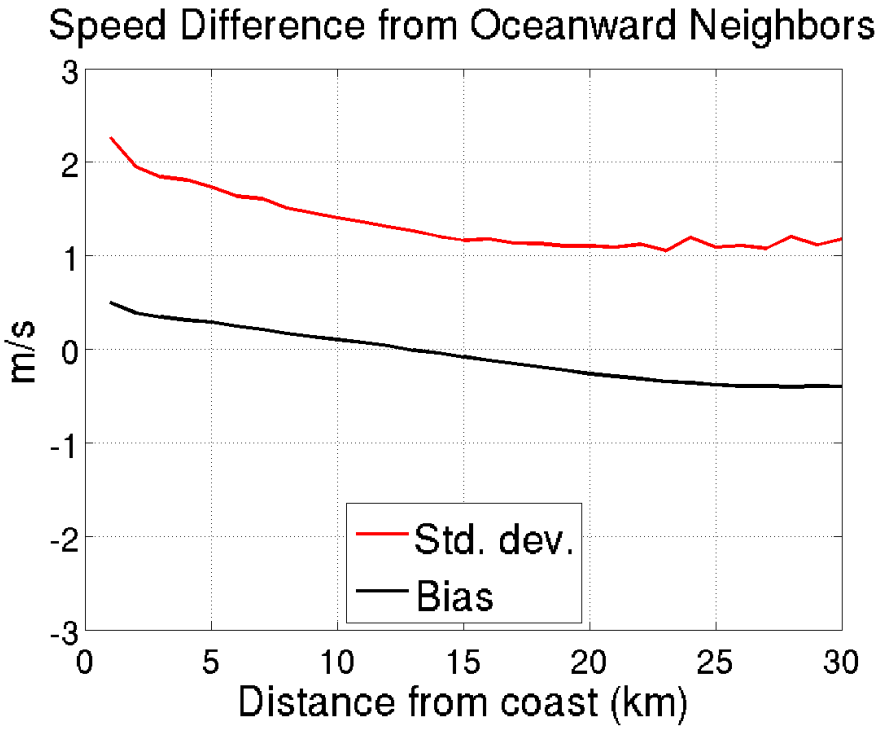




- Version 4 has at least 10X as many buoy hits within 20-km of the coast as version 3.
- All available NDBC buoys were utilized because “bad buoy flags” tend to exclude coastal buoys.
- Two trends are apparent:
  1. Differences from buoys decrease out to 100-km (more spatial variance closer to shore?)
  2. A steeper trend from 0 to 20-km perhaps due to residual errors in coastal processing.
     - Agreement 10-km from coast is only marginally worse than 30-40-km.
     - Agreement within 5-km from the coast shows significant degradation.
     - Distance from the coast is included in the product.

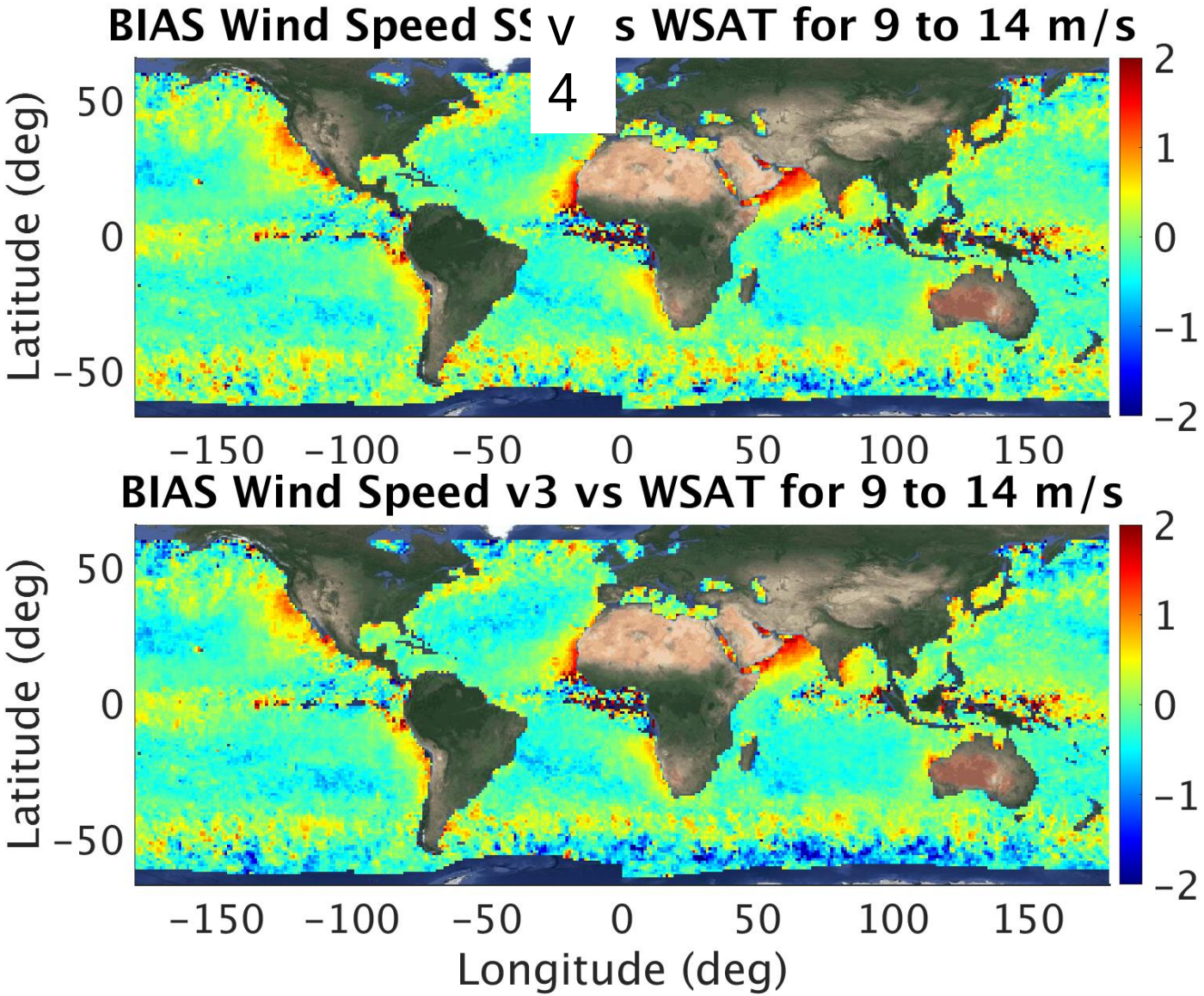
Coastal Wind Performance vs. Oceanward Neighbors





- Version 4 retrieves substantially more winds near the coast than 3 or 3.1.
- Comparing wind speeds to oceanward neighboring wind vector cells rather than buoys yields a slight trend in differences from 0 to 30-km from the coast.
- The oceanward neighbors results suggest small residual errors in the coastal processing

SST-dependent GMF, Speed Bias w.r.t WindSAT

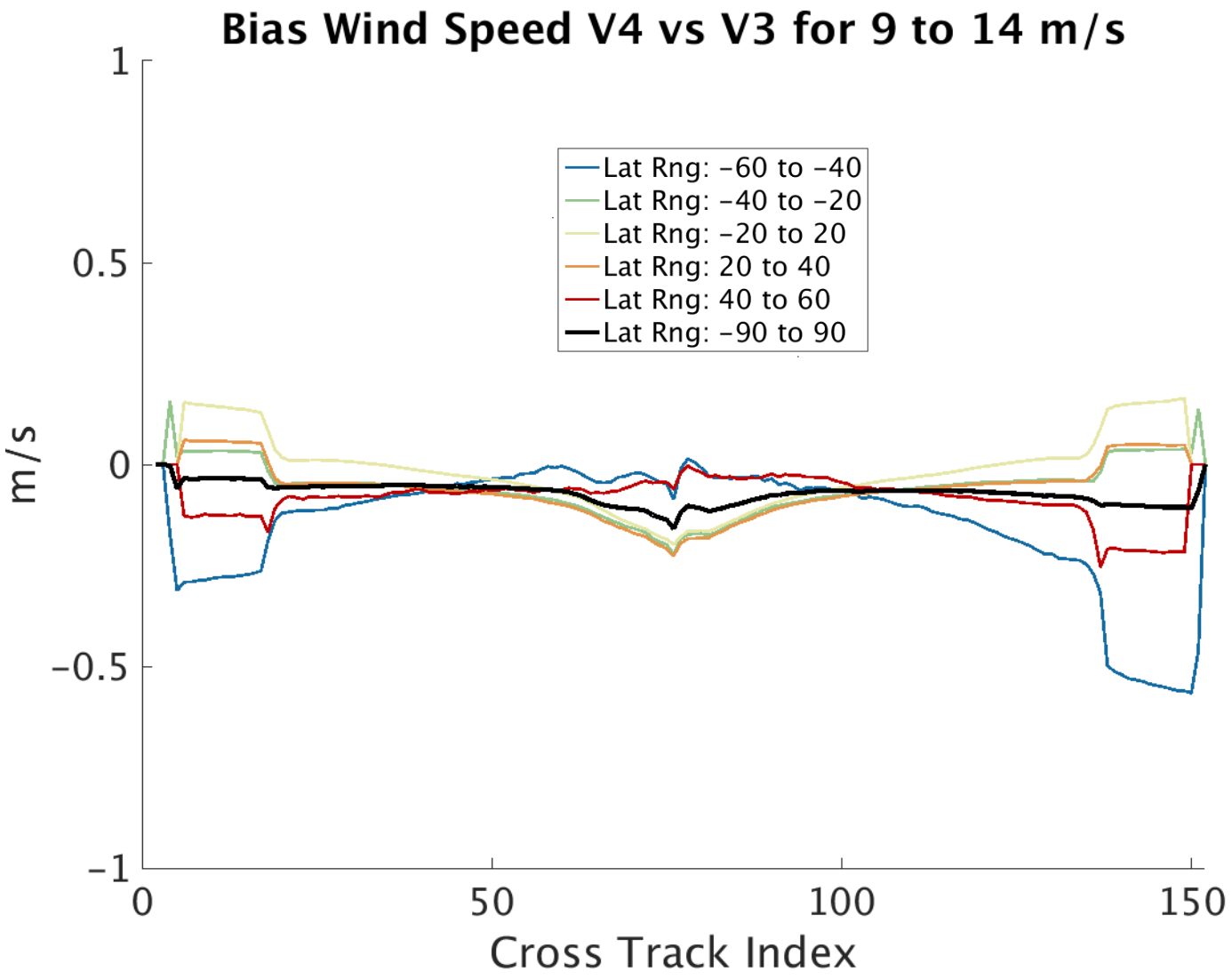


The new GMF removes a significant negative speed bias for latitudes near the poles.

This bias is due to biases in the outer single beam portion of the swath.

VV the only polarization present in the outer swath is more sensitive to SST.

SST-dependent GMF, Effect on Speed Bias
V3 speeds – V4 speeds



This plot shows the speed difference between version 3 and version 4.

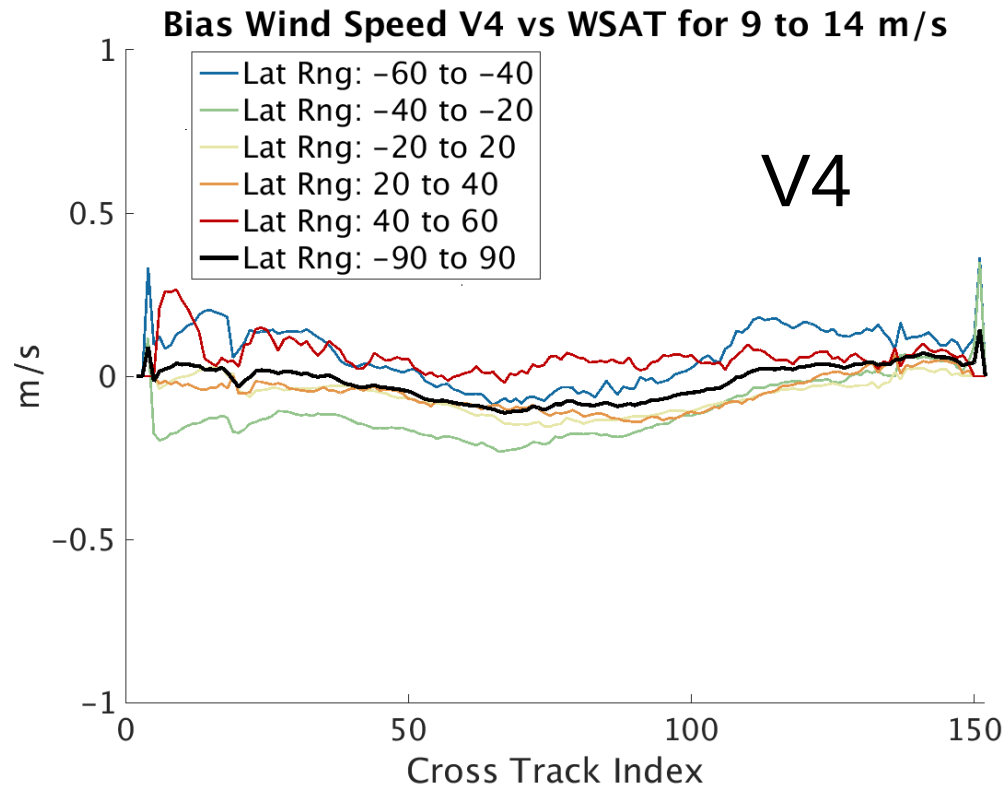
The primary difference is in the outer VV only swath.

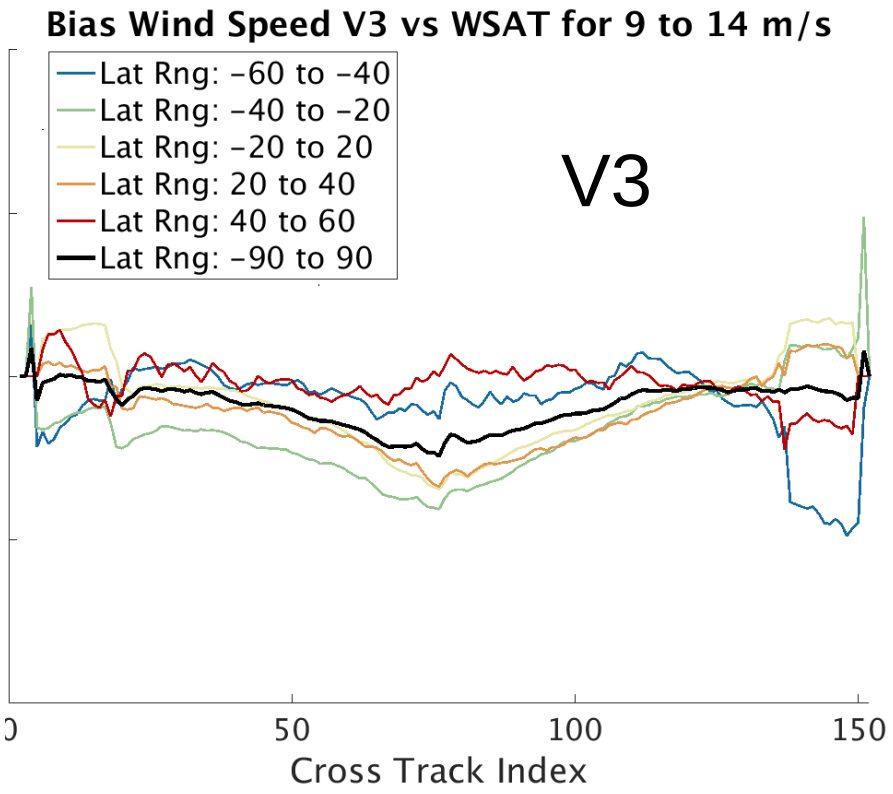
The effect is most pronounced for low SST latitudes.

A similar sign reversed effect is present for higher SST areas.

There is also a difference near nadir.

SST dependent GMF Speed Bias w.r.t WindSAT





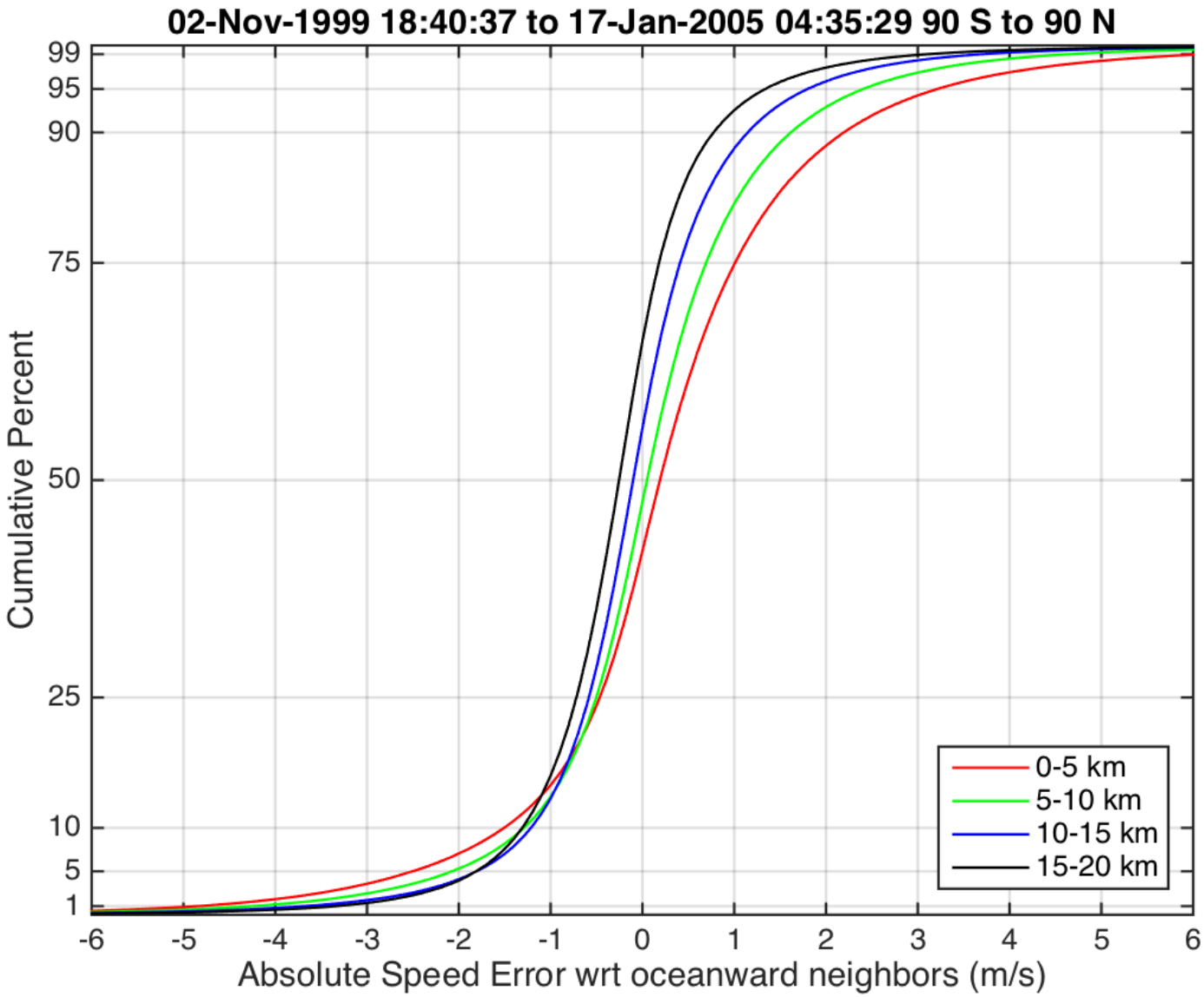
- Speed biases in outer swath are clearly smaller for V4.
- Speed biases at nadir are also reduced.

Summary

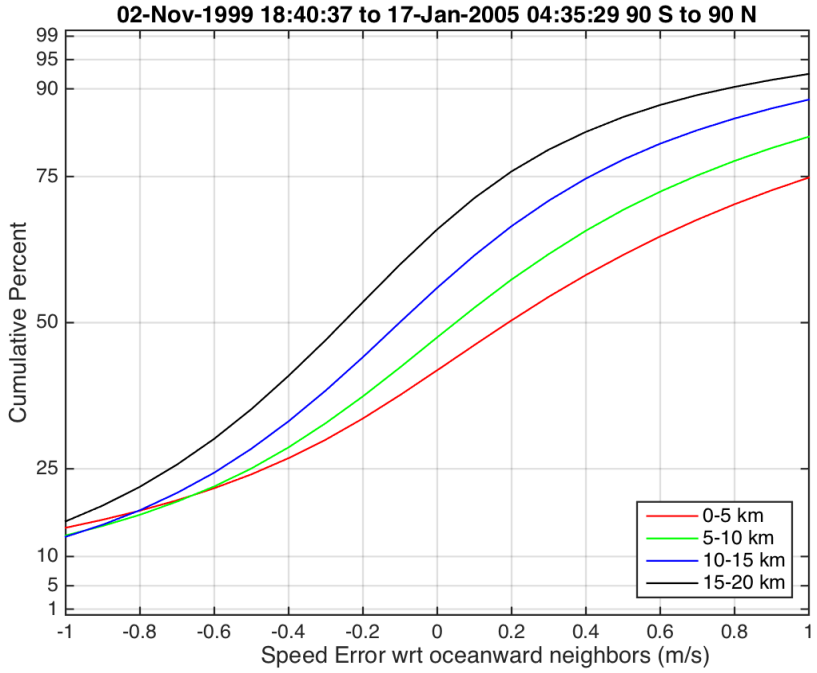
- The QuikSCAT Version 4.0 climate quality data set is now publicly available.
- It retrieves winds closer to the coast than ever before.
  - *These winds are enabling studies of the relationship between ocean wind, currents and bioproductivity in places like the Chilean Inland Sea.*
  - *Coastal winds agree with buoys greater than 10-km form the coast*
  - *Coastal winds agree with oceanward neighbors greater than 5 km from the coast.*
- It contains an SST-dependent GMF that
  - *Reduces biases with cross track distance for latitudes with low SST.*
  - *The primary effect is on VV polarization and thus on outer single beam portion of the swath.*
- It contains simplified quality flags and additional quality information.
- Questions?

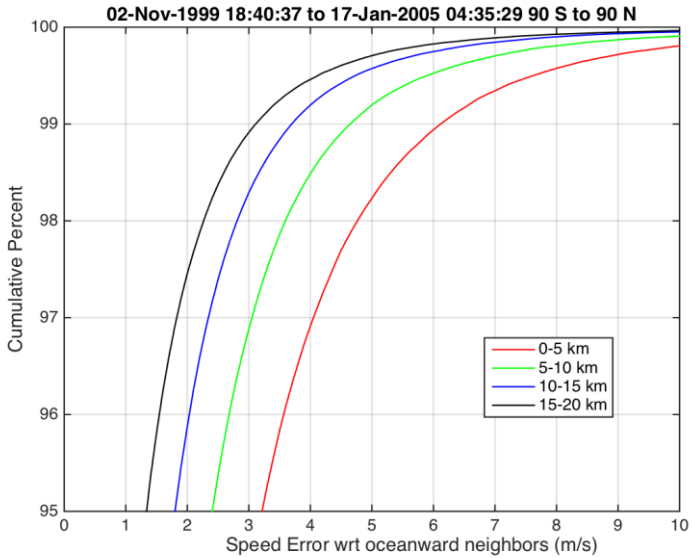
Backup Slides

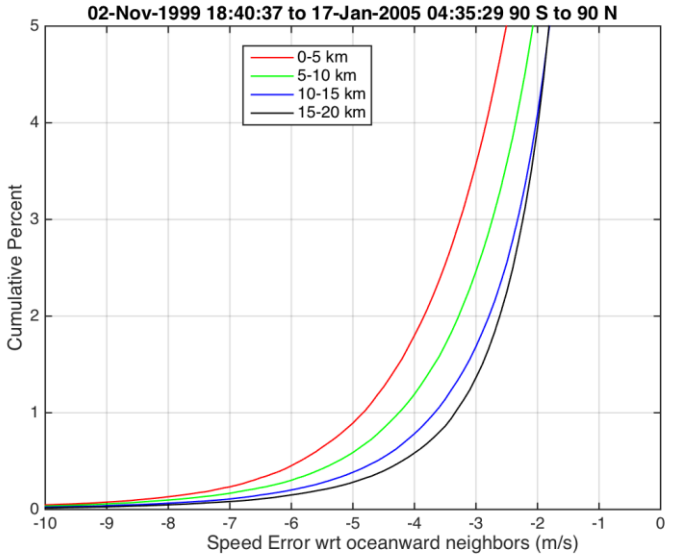
Coastal Wind Performance



Coastal Wind Performance







Summary of Flag Bits (new bits in red)

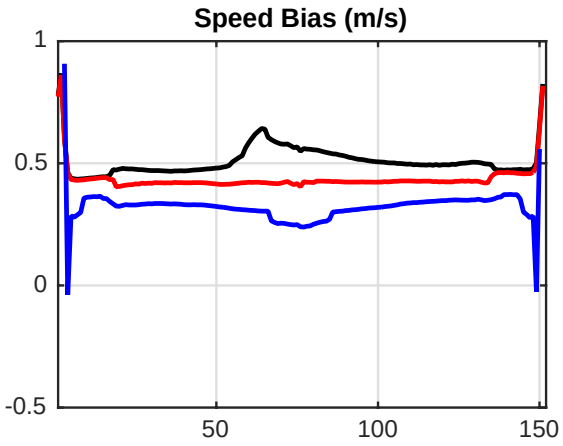
Variable ShortName flags LongName "Wind Vector Cell Quality Flags"

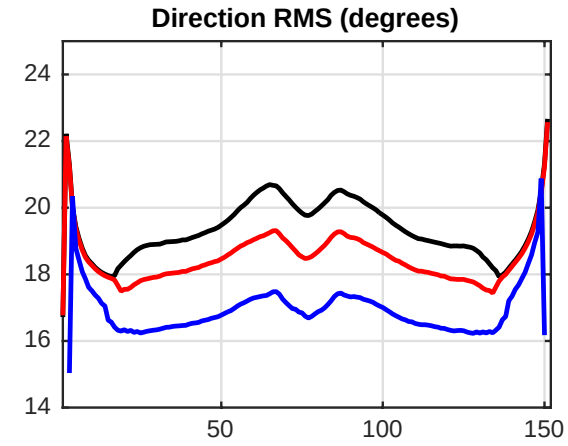
Bit 0: name adequate_sigma0_flag	Fewer than 4 sigma-0 values in wind vector cell, winds not retrieved
Bit 1: name adequate_azimuth_diversity_flag	Less than 20 degrees of azimuth diversity, winds not retrieved
Bit 2: name undefined_bit	
Bit 3: name undefined_bit	
Bit 4: name undefined_bit	
Bit 5: name poor_coastal_processing_flag	Currently never set (unless wind is not retrieved)
Bit 6: name wind_retrieval_likely_corrupted_flag	Recommended flag, flags 3% of data when either sea_ice, or rain is present.
Bit 7: name coastal_flag	At least one measurement in wind vector cell within 20 km of land.
Bit 8: name ice_edge_flag	At least one measurement in cell determined to be sea-ice contaminated
Bit 9: name winds_not_retrieved_flag	No wind vector retrieved
Bit 10: name high_wind_speed_flag	Retrieved wind speed greater than 30 m/s
Bit 11: name low_wind_speed_flag	Retrieved wind speed less than 3 m/s
Bit 12: name rain_impact_flag_not_usable_flag	Rain impact (IMUDH) flag is not computed, presence of rain unknown
Bit 13: name rain_impact_flag	Rain impact (IMUDH) flag, rain detected in cell
Bit 14: name missing_look_flag	At least one of the four azimuth looks is unavailable for this cell
Bit 15: name undefined_bit	

Variable ShortName eflags LongName "Extended Wind Vector Cell Quality Flags"

Bit 0: name rain_correction_not_applied_flag	Rain correction was not applied, this is typical when no rain is present
Bit 1: name correction_produced_negative_spd_flag	Rain correction produced a negative speed
Bit 2: name all_ambiguities_contribute_to_nudging_flag	All of the ambiguities in the cell were used during nudging
Bit 3: name large_rain_correction_flag	Rain correction to wind speed was larger than 1.0 m/s
Bit 4: name coastal_processing_applied_flag	Wind vector cell is close to the coast and coastal processing was performed.
Bit 5: name undefined_bit	
Bit 6: name undefined_bit	
Bit 7: name undefined_bit	
Bit 8: name rain_nearby_flag	Rain detected within 50 km of cell.
Bit 9: name ice_nearby_flag	Sea ice detected within 50 km of cell
Bit 10: name significant_rain_correction_flag	Rain speed correction was larger than 0.1 m/s
Bit 11: name rain_correction_applied_flag	Rain correction was applied, inverse of bit 0.
Bit 12: name wind_retrieval_possibly_corrupted_flag	Strict flag, flags 15% of data with rain or sea ice is nearby or coastal processing performed
Bit 13: name undefined_bit	
Bit 14: name undefined_bit	
Bit 15: name undefined_bit	

Simplified Flagging Performance (Wind difference statistics w.r.t ECMWF)



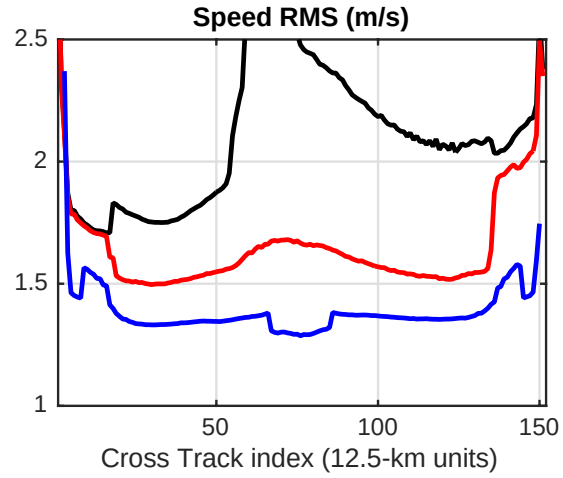


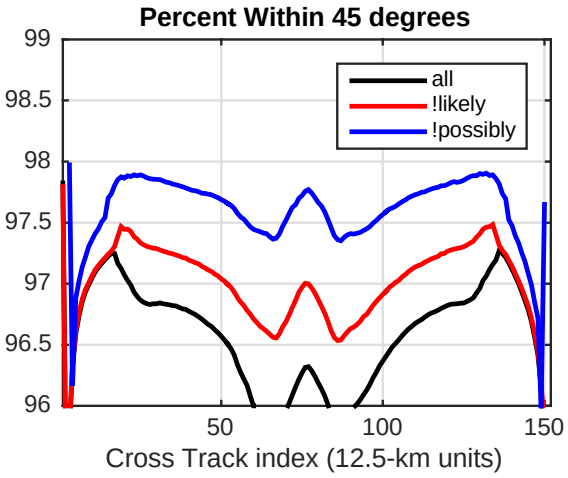
Likely Corrupted mean one of these is true

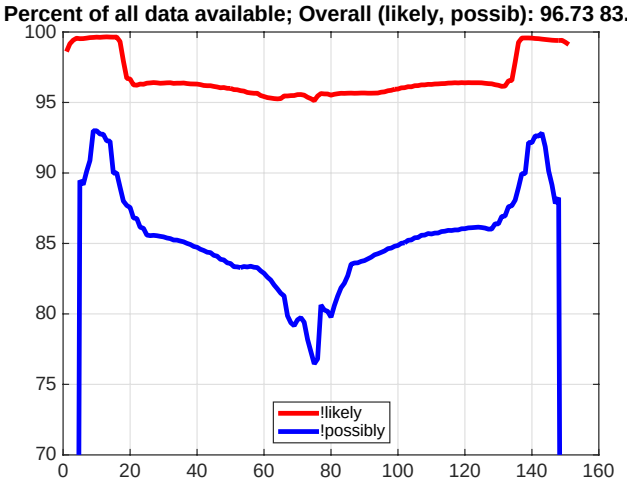
- Autonomous Rain Flag (IMUDH) indicates rain contamination.
- Speed corrected by more than 2 m/s
- Sea ice found in Wind Vector Cell
- Scatterometer rain flag unavailable and radiometer indicates rain within 90 minutes
- Wind was not retrieved

Possibly corrupted means one of these is true

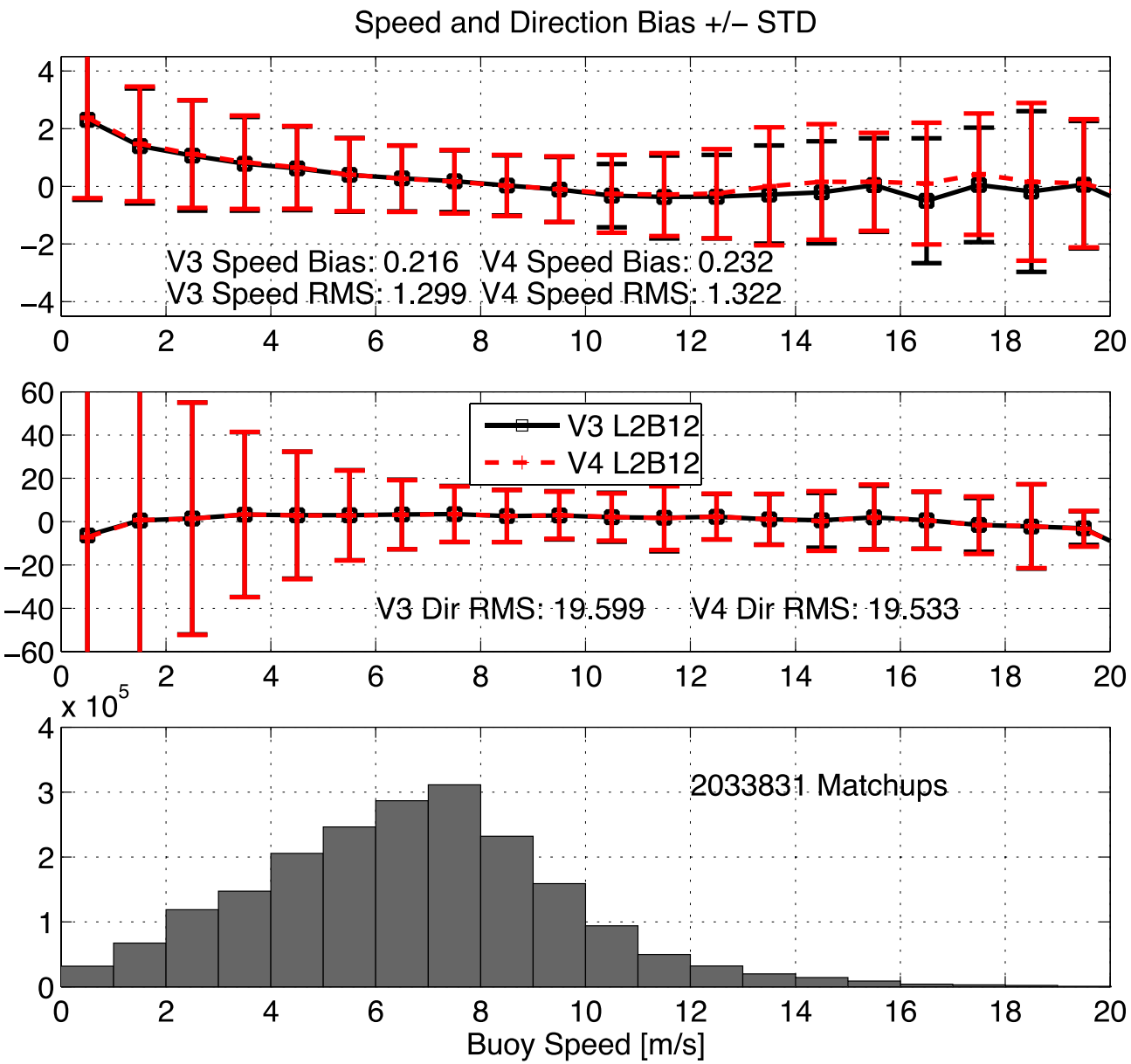
- Likely Corrupted Bit set
- Rain flag set within 50-km
- Sea-ice flag set within 50-km
- Speed was corrected for rain by more than 0.1 m/s



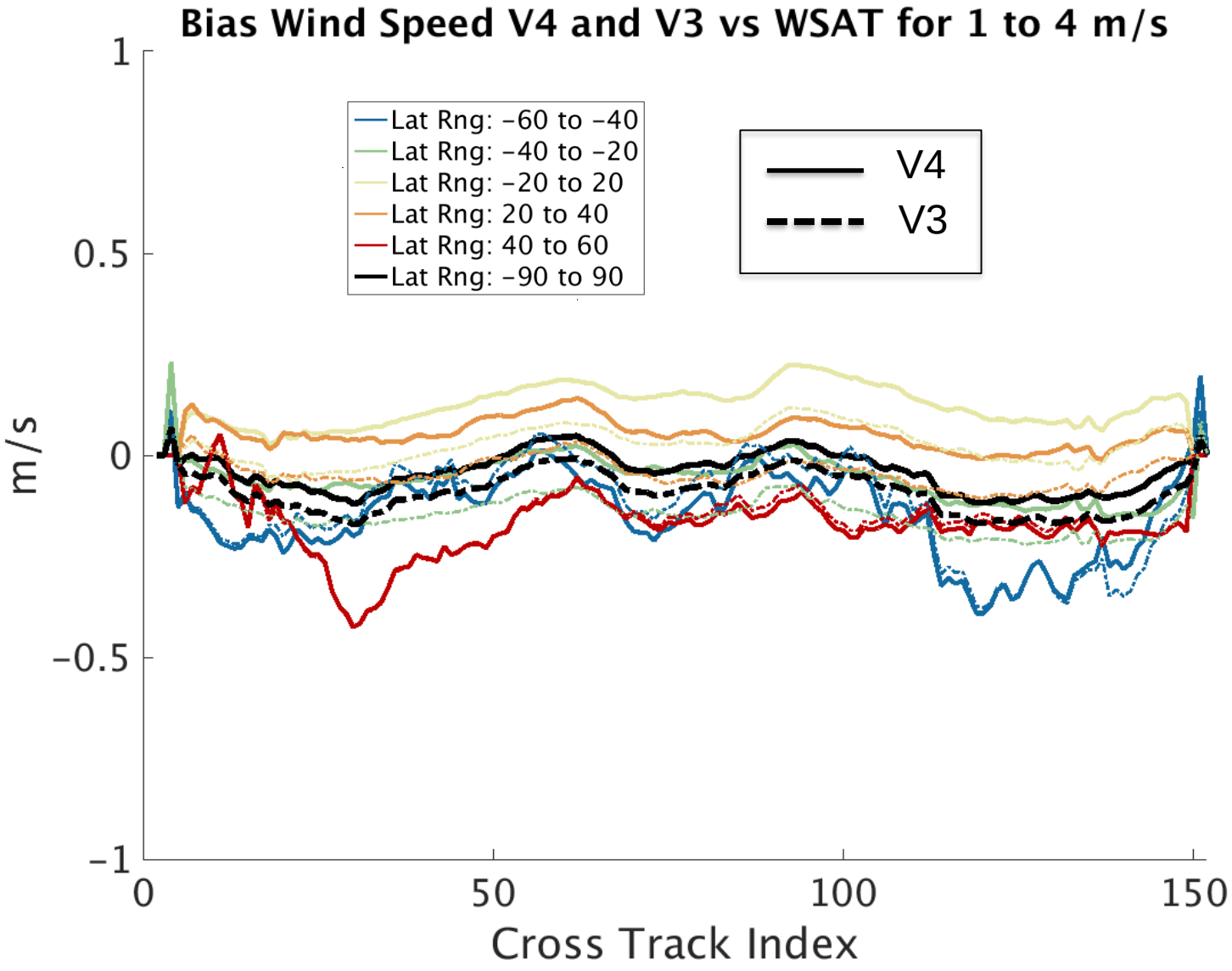




Buoy Comparison for 2008 data



SST dependent GMF
Speed Bias w.r.t WindSAT



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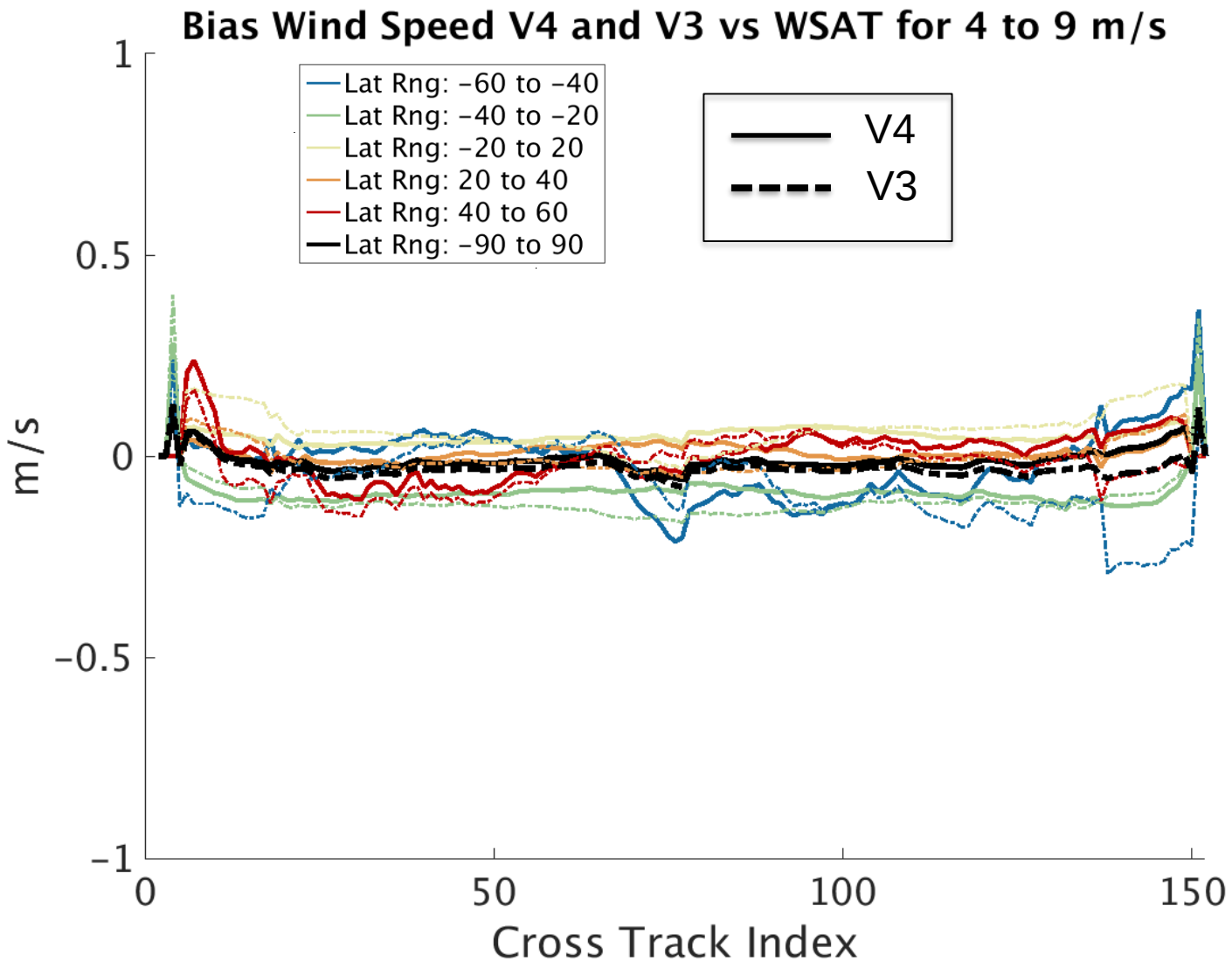

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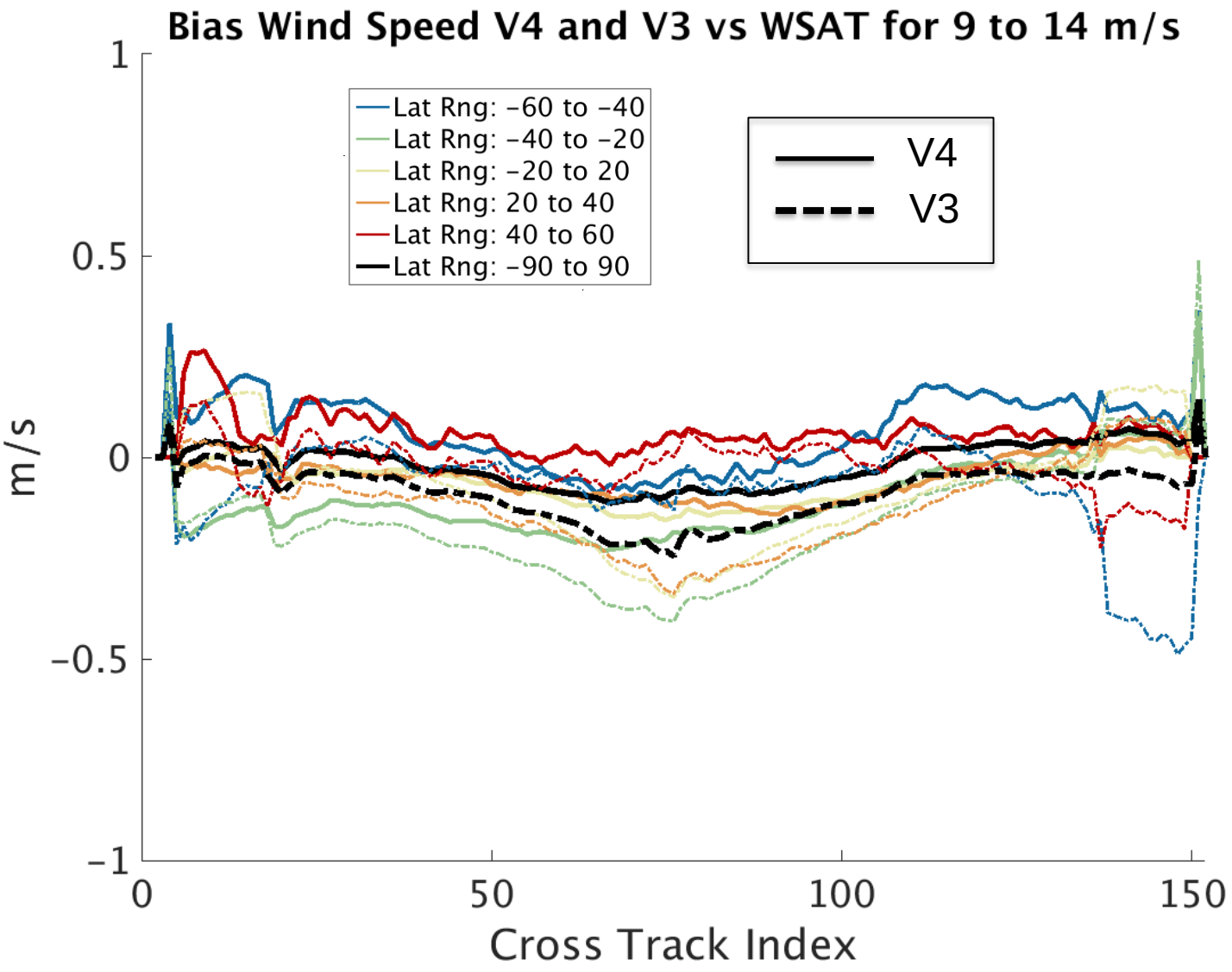

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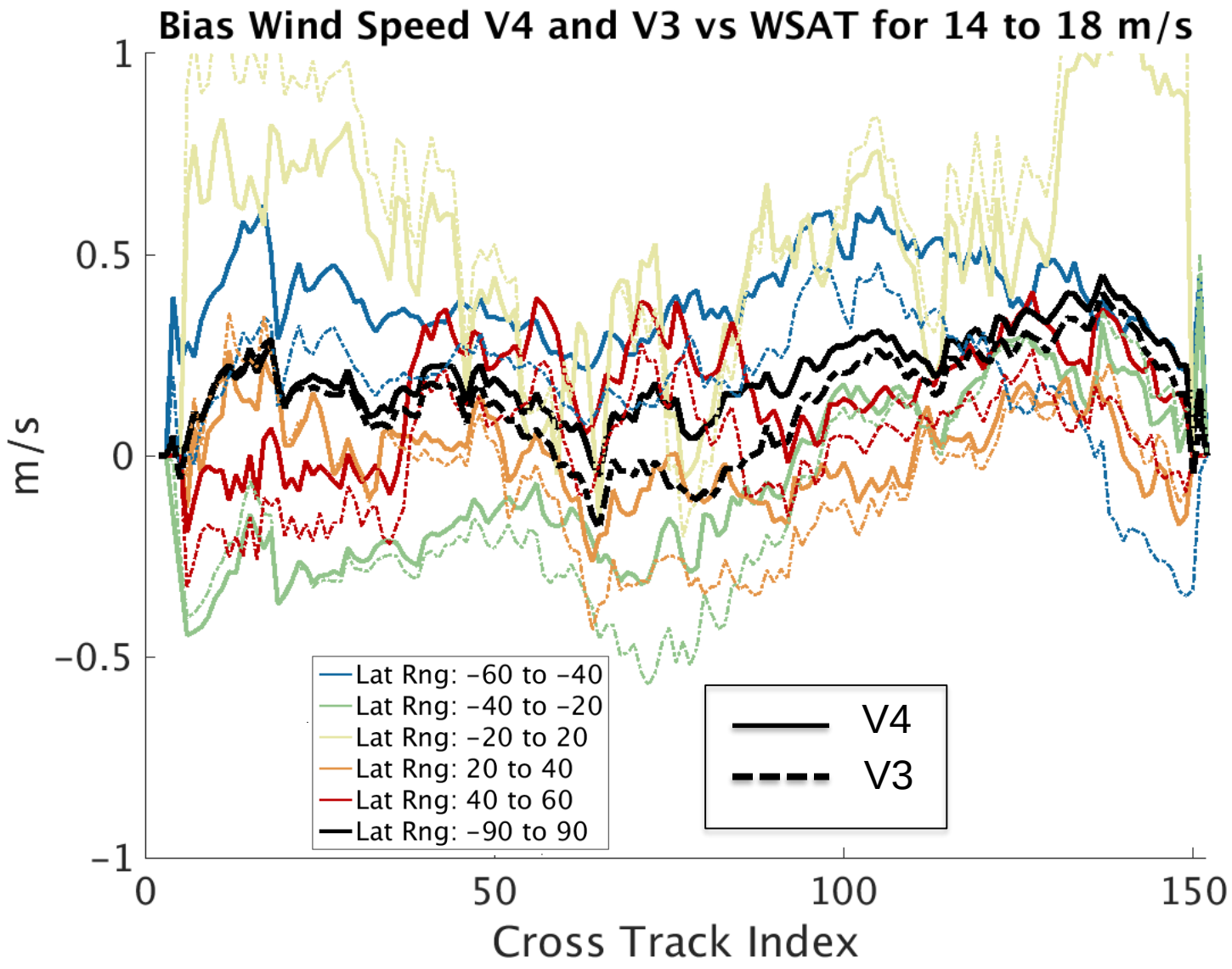
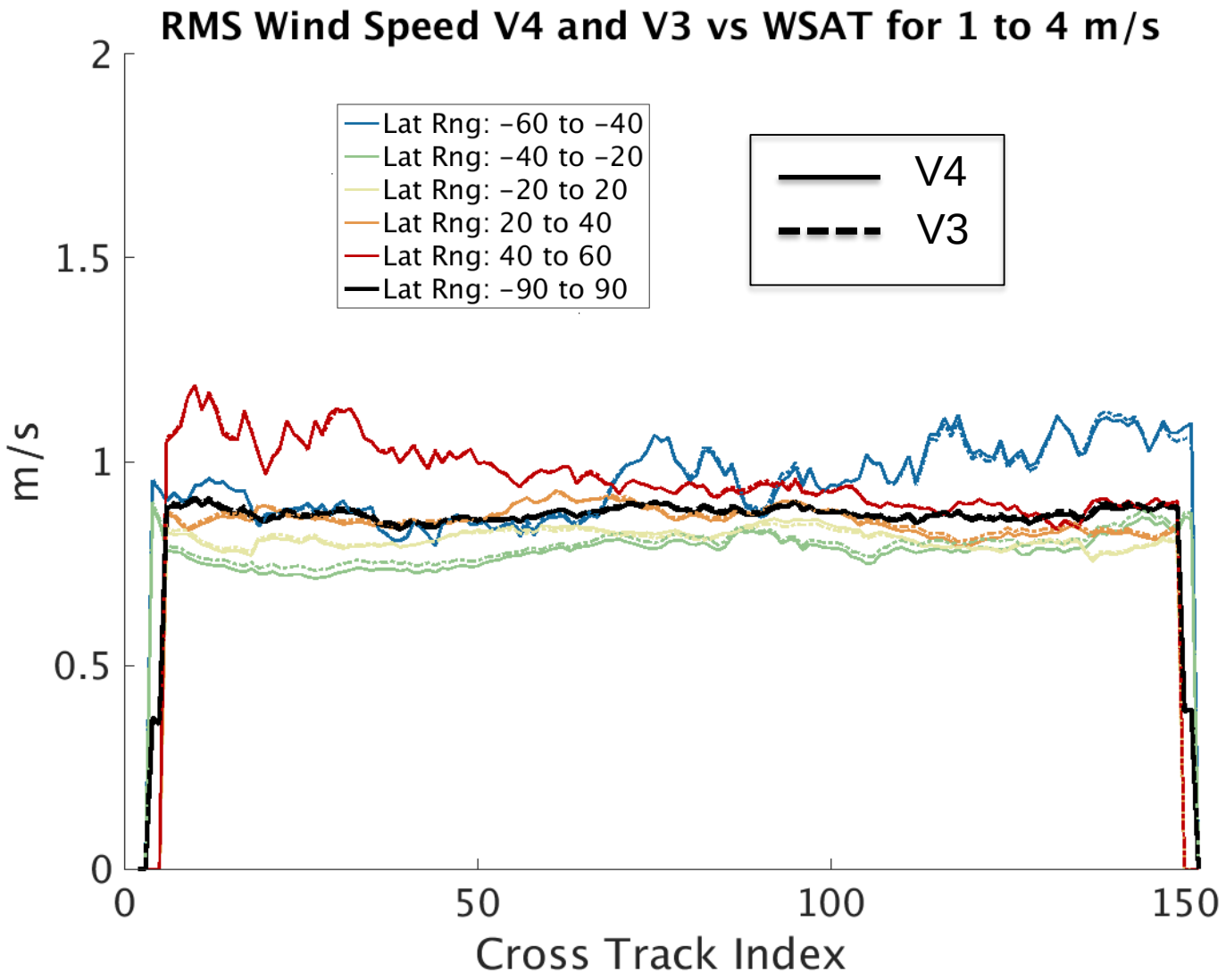


SST dependent GMF
Speed RMS w.r.t WindSAT



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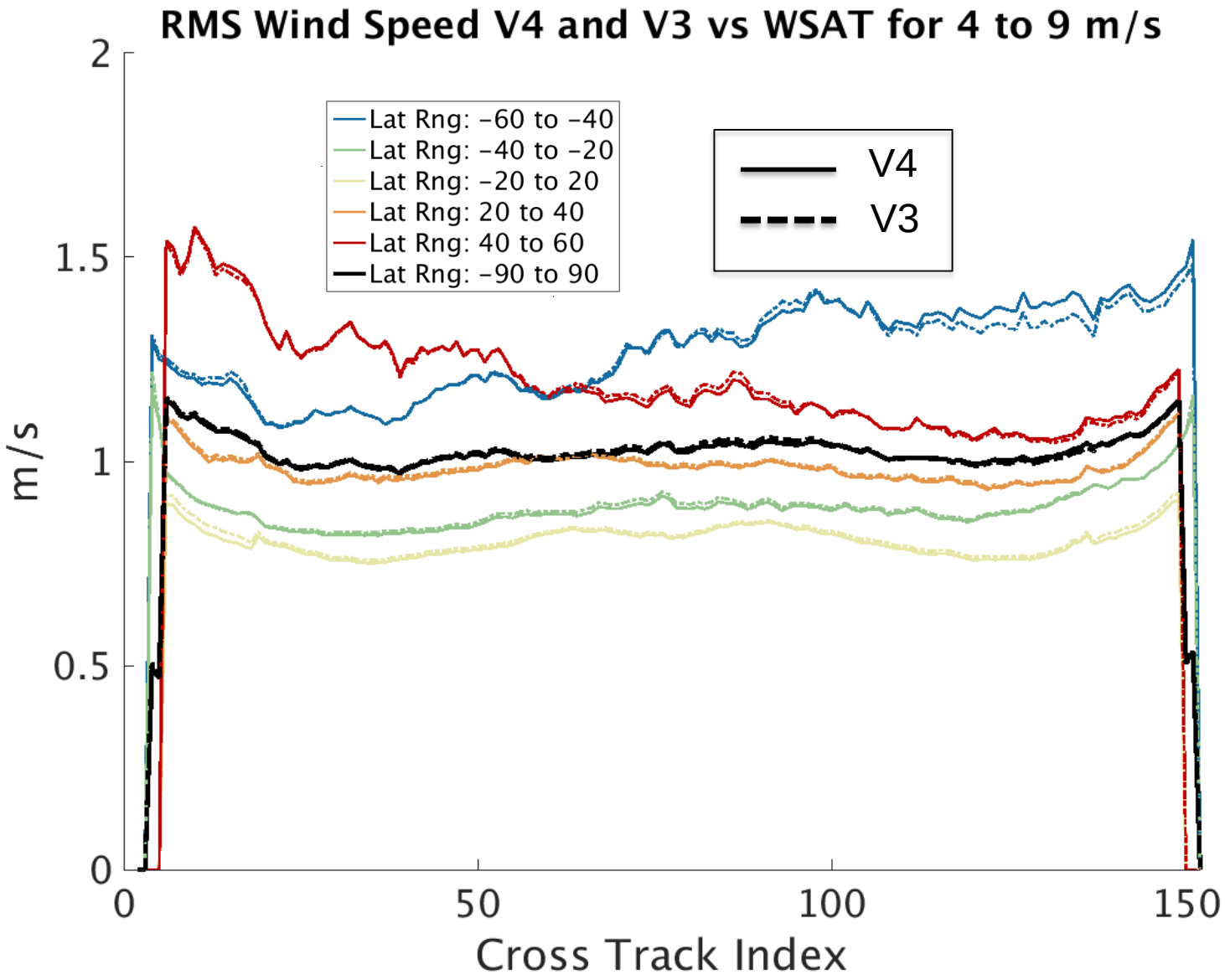
Speed RMS w.r.t WindSAT



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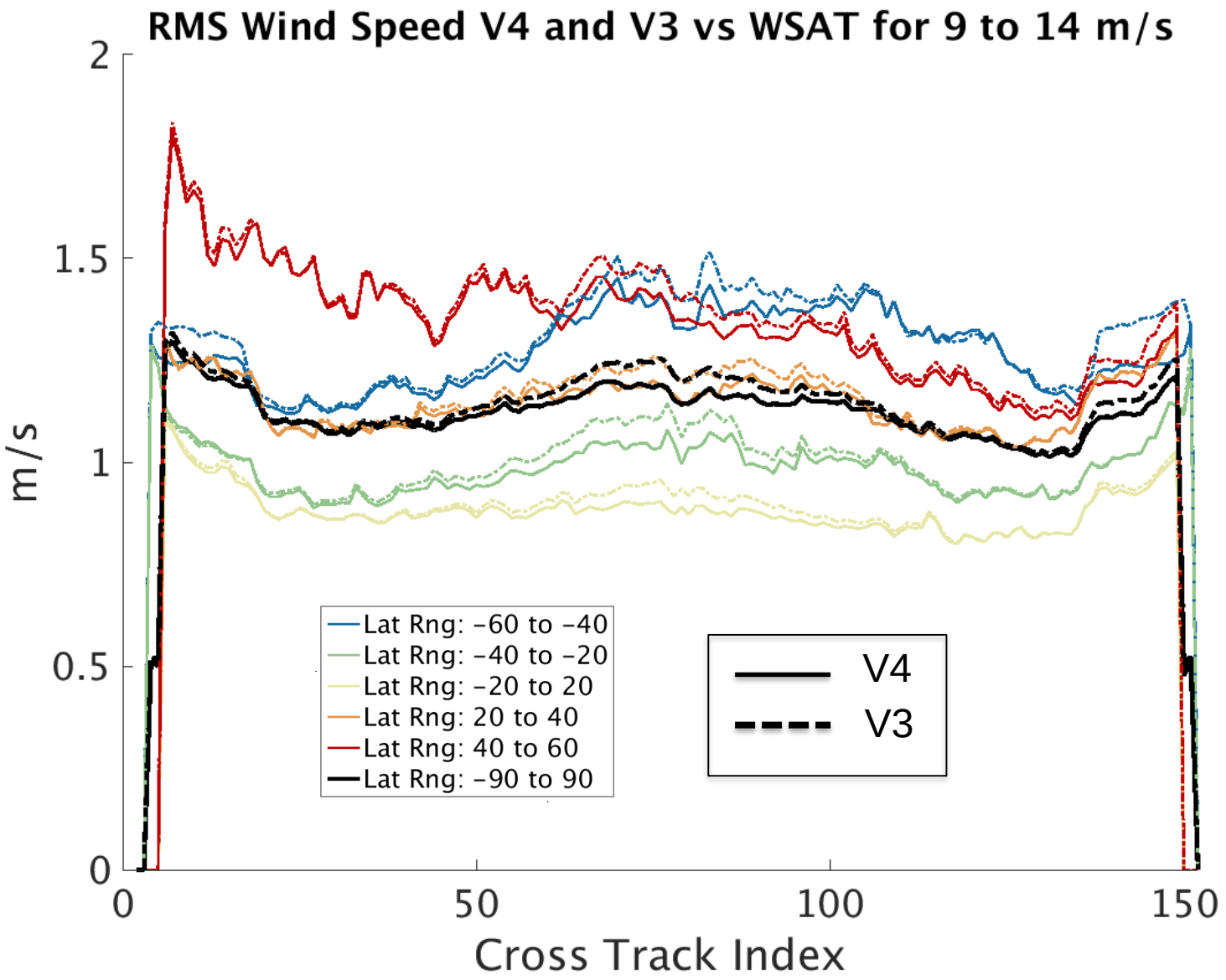
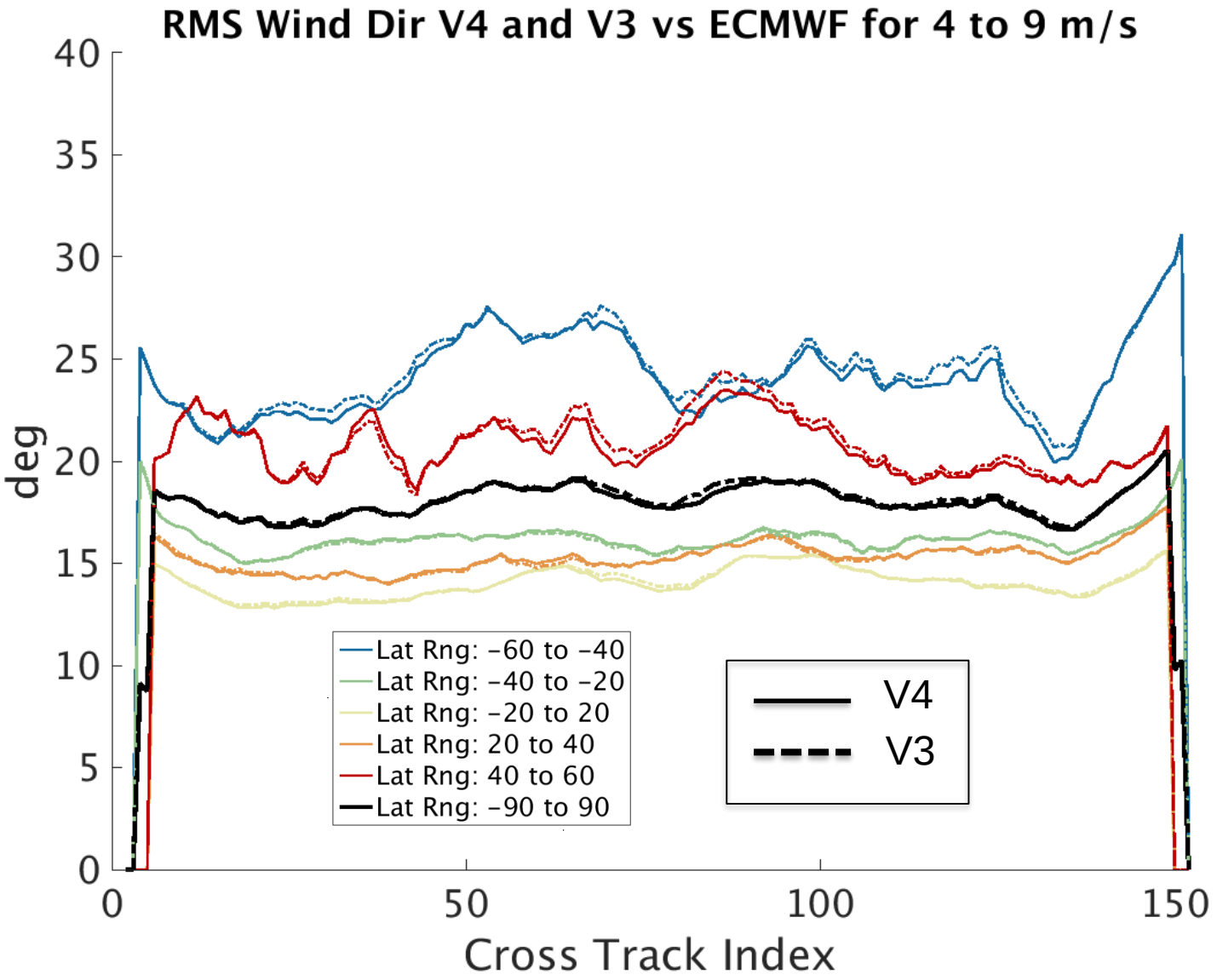
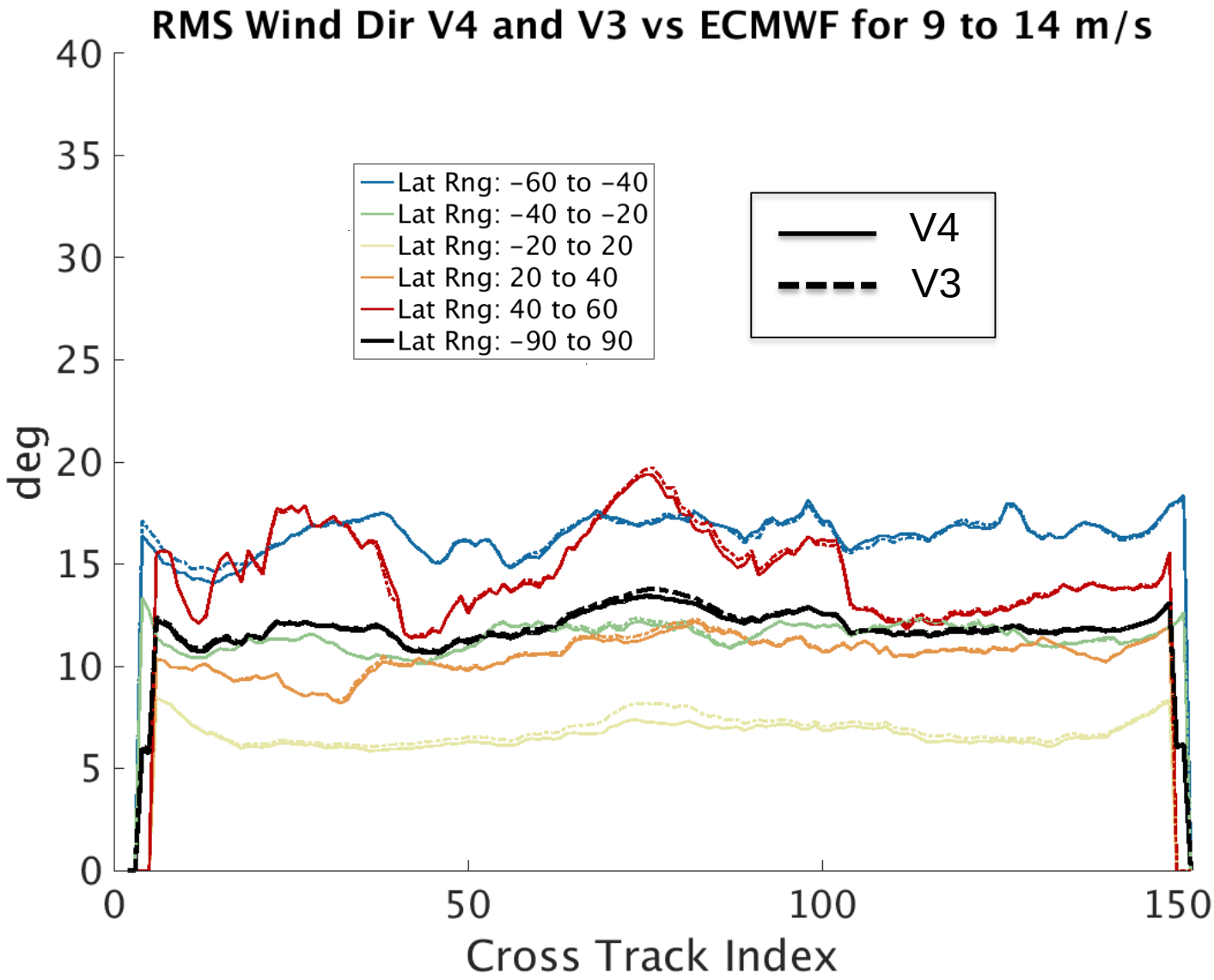
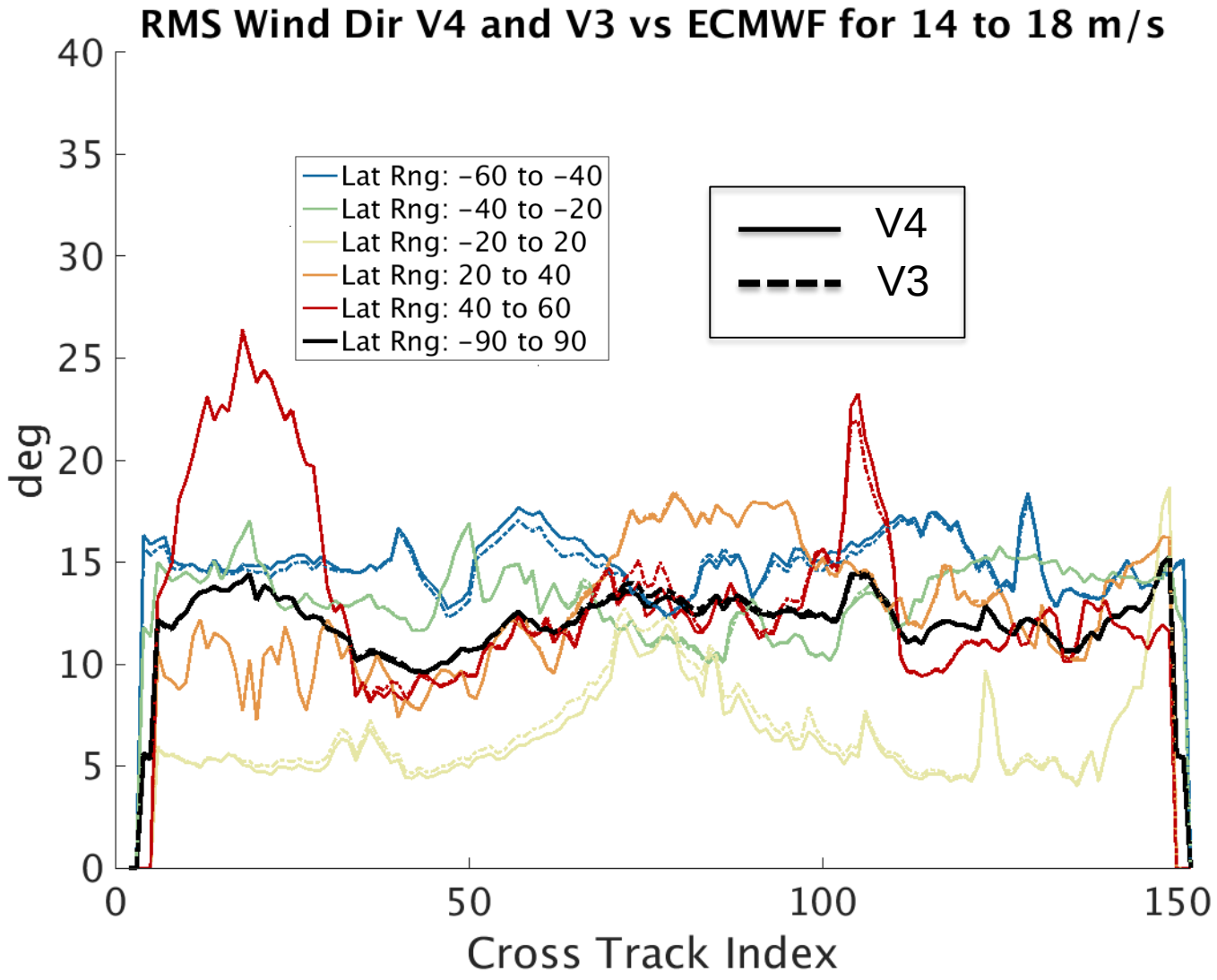
Speed RMS w.r.t WindSAT



SST dependent GMF
Direction RMS w.r.t ECMWF



SST dependent GMF
Direction RMS w.r.t ECMWF



SST dependent GMF
Direction RMS w.r.t ECMWF